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Notes on Modes of Work in the Laboratory of Prof. de Bary in Strassburg, Germany. II. – Having in the last number of the GAZETTE given some statements as to the instrumental outfit of the Laboratory of Prof. de Bary in Strassburg, I desire now to add something as to modes of observation and culture of the lower forms of plant life. Commencing with Fungi, it is safe to say that the first desideratum is to procure living spores, to see mode of germination and trace the subsequent stages so far as practicable. The first question invariably asked me is, in what menstruum are these spores soon? This reply is safe. Try them in simple water first. It will be found that the spores of fungi parasitic upon living plants do well almost invariably in water, until the nourishment has been removed from the spore and reapplied to growth in the germinating tubes of the spores. But when this stage has arrived, a new menstruum must be found, and one as nearly like that of the juice of the plant on which the fungus thrives. For example, a weak solution of well cooked grape sugar would suggest itself for any of the species of fungi which infest the grape vine. In other cases a decoction of bones will produce a vigorous development of the fungus after the water has done its work.

Now how are the spores sown? In very simple contrivances. It appears to be an unfortunate outgrowth of the inventive, mechanical principle so largely characteristic of our race that we ignore simple appliances and run recklessly to complicated machinery for very simple objects. I keep before me as a reminder of supreme folly an elaborate brass growing cell for which I paid five dollars, and then found it was by no means so good as the simple paper "culture-well" used by de Bary and his disciples. This is nothing but a bit of bibulous brown pasteboard one-tenth of an inch thick, and 1.8 inches long by 1.1 inches wide, which has punched (by a gun-wad punch) in the center a hole something more than half an inch in diameter. This first of all must be boiled slightly before using to remove the suspicion of spores that might invalidate results obtained in the cell. This cell is then placed on a glass slide a very little larger, and the spores sown in a hanging drop of water on the under side of the cover glass, but this drop must not touch the paper at any point, lest the whole be drawn off and the cover and spores left dry. In such a cell cultures may be continued for a great length of time; long enough to solve the ordinary life problems for which they are designed. To keep the cell moist and the hanging drop intact and unwasted by evaporation, a little jet of water from time to time thrown on the paper outside the limits of

the cover glass will accomplish the purpose, and this must not be neglected while the object is under observation on the microscope, for it there dries very quickly. Now to keep the slide and its culture-well in good condition, you may have a little brass rack with two upright pieces, say ½ inch wide and three or four inches high for the ends and these connected by horizontal rods, two of which shall form the platform for one set of slides and two more half an inch higher for another set, so you may have several tiers over each other. Then on such a rack you place your slide, put this on a dish with a *little* water, and a bell-glass over all. Inside the bell-glass a bit of thin blotting paper may be placed, which being made moist will aid in keeping the contained air at point of saturation and so prevent drying of spores in cover glass; or, the slide with the culture well and its contained drop and spores, may be left over night on the microscope if desired, to observe one particular spore or point, provided the well is thoroughly moistened and then the bell glass which covers the microscope provided with the wet blotting paper, just as the bell glass over the rack. So the whole instrument may be placed in a growing cell. Spores may however be sown directly upon a glass slide, without the culture-well, and cared for as those in the culture-well, but it is apparent they are liable to contamination from outside and undesired spores. One great source of error with the beginner in spore culture is, that he sows too many on a slide, and as they grow the whole becomes a confused and tangled mass, which can hardly be said to teach any mycological point with certainty. In this connection the student should read pp. 239 to 242 of Prof. Bessey's admirable text book on Botany, which I am almost tempted to say is the best work of its kind in the English Language. It is a perfect marvel of compact, well considered, biological doctrines, and whatever else a student has he should have this too. Leaf cultures, by which I mean producing a fungal growth on a leaf suspected to contain the spores or the mycelium. is simple enough. One merely needs to place the leaf on sand which has been previously boiled to kill germs, and then allowed to cool. The sand should not be kept wet or the leaf may rot too soon, but a simple dampness maintained. To do this I find a good plan is to place the sand and leaf in an unglazed clay flower pot dish, and this in a larger table plate, then keep an eighth of an inch of water in the latter; it soaks up through the clay dish and sand and moistens the leaf and air satisfactorily. I have now a leaf which three weeks ago gave no sign of perithecia, literally covered with a most promising crop of these or like bodies, and the result brought about by the simple process I have described. Of course over the leaf a tumbler or similar protection must be inverted to prevent evaporation and to keep away stray spores. If the plan proposed makes the sand too damp, simply use less water. To obtain spores from such a leaf, one merely requires to invert a bit of the leaf on a glass slide, then place a drop of water over the spore producing part The moisture imbibed soon causes an expulsion in sufficient numbers to continue the culture. If however one would have a starting point of absolute certainty he must remove an isolated perithecium, gently open it on the glass slide and allow the spores to escape in a drop of water. From this he may reason and observe with some assurance that he is right, and has the product of known spores.

Lichen culture receives a due share of attention. In fact the early researches of de Bary paved the way to the generalizations of Schwendener. Whatever view one may adopt as to the essential nature of lichens, their culture is of great interest. The favorite species for observation is *Endocarpon pusillum*, Hedwig. (*Dermatocarpon Schœreri*, Kœrber). These are collected in the late autumn, and enough of the clay removed with them to keep them alive in healthy condition until required. No water must be given them until they are taken for the cultures, otherwise the spores and small gonidia contained in the apothecia will be prematurely extruded. The spores and gonidia are to be sown in a flower pot dish, on clay which has been thoroughly boiled, and then the surface made smooth as possible, which makes it easier to detect the first sign of the growing lichen. The lichens are then taken along with the surrounding clay, nicely bedded in sand and supports provided on which the edges of the inverted clay containing dish, may rest so that the surface of the moist clay is about one fourth of an inch from the lichen. The lichens are now sprinkled with water and the dish placed in position over them. Spores and gonidia will be extruded in association, and after 24 hours the dish may be removed and put under a bell glass in a light place which is not too damp nor too cold, i. e. temperature something above freezing. While the dish is inverted it should be turned round a little about every half hour to secure a distribution of the spores and gonidia over the surface, and small bits of "cover glass" may be placed here and there on the surface, which being removed will show under the microscope if the spores are escaping properly. The growing spores are handsome objects mounted in glycerine and quite instructive. These may be obtained by placing the glass slip over the lichens as the dish was placed, and afterwards setting it away in a moist place for a few days. It is to be observed that if the dish on which the spores and gonidia are sown be kept too moist and too warm at first, fungi will probably injure the culture. For fuller particulars of the process the reader is referred to Prof. Stahl's Paper, Beitrage zur Entwickelungogeschichte der Fletchen. Heft. II; ueber die Bedentung der Hymenial gonidien. Leipsic, 1877. Arthur Felix.

Pertusaria is also another favorite group, the gonidia of which are obtained by immersion of the brittle crustaceous mass in water, allowing them to multiply and form zoospores, and then placing them in association with the spores.

A plentiful supply of fresh water Algæ is always on hand. These are kept in glass jars, which stand in the windows and under cover of a bit of glass. Of course the water is frequently changed, and so with little trouble these may be observed in the various stages of growth, throughout the year.

The above hastily written notes will suffice to give an outline as to the modes of culture employed in the celebrated laboratory in Strassburg. Special inquiries demand special adaptations, and these will readily enough suggest themselves to an observer. A noteworthy feature is the extreme care observed by Prof. de Bary in keeping his growing solutions free from foreign spores by boiling and if need be, filtering before using. Boiled or distilled water is used for all ordina-

ry table work in the laboratory, and forceps, needles, and knives used in microscopic manipulation are treated to frequent boiling baths.—J. T. ROTHROCK.

Audibertia Vaseyi, n. sp.—A low, branching shrub; flowering branches stout and rigid, the herbaceous upper portions whitish, cinereous puberulent and viscid-glandular; leaves lance-ovate, acute or obtusish, 1 to 1½ inches long, narrowed into rather slender petioles ¼ to ½ an inch long, crenulate, not manifestly rugose, coated with a close white tomentum; heads of flowers about 6, in virgate spikes, 1 to 2 inches apart, lower ones subtended by a pair of leaf-like bracts; the inner floral bracts lanceolate to linear, setaceously acuminate; broad upper lips of the calyx furnished with a single conspicuous awn, the two teeth of the lower one likewise awned; corollas from ½ to ⅔ of an inch in length, exceeding the bracts; stamens and styles exserted

Mountain Springs, San Diego county, California, June 1880. This plant is No. 500 of a large and fine collection made last summer in lower California by Mr. G. R. Vasey, in whose honor it is named.—THOS. C. PORTER, *Easton, Pa.*

Carnivorous Plants. V.—EXPERIMENT NO. XII.—Placed upon a leaf a small fiber of muscle drawn from a piece of boiled beef, at 3 P. M., June 12, '79. The fiber was teased out from the mass of muscles and rolled into a ball having its diameter about 1-12 of an inch.

15 min. no change visible.

30 " a few of the submarginal tentacles had inflected slightly.

45 " the tentacles of last note nearly touched the specimen; a number of the other submarginal tentacles had moved considerably; a few of the marginal tentacles were also inflected.

1 hr. all the submarginal tentacles were more or less inflected and nearly all touched the meat; all but ten of the marginal tentacles were also inflected, varying in degree; the ten were still fully reflexed. To four of these another experiment was applied which will be fully explained in its proper place.

2 hrs. practically there was no change except that six of the ten marginal tentacles mentioned in last note had inflected slightly.

3 " no important change.

15 " all the tentacles were inflected and touched the meat except the four mentioned above which still normally reflexed.

24 " the edges of the leaf still remained normal.

48 " the meat upon the leaf seemed to be enclosed in a semi-transparent fluid containing fat globules as shown by removing a portion by a blunt needle and placing under the microscope. The globules were soluble in ether. The body of the meat itself had assumed a dark brown color. The tentacles and leaf remained the same as the last note.

72 " nothing but an opaque yellowish substance remained upon the leaf.

96 " there was but little change.

120 " the opaque substance upon the leaf had changed into a nearly transparent thickish fluid.